Journal of Dental Sciences (2010) 5, 183–188

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

Original Article

Treatment modalities for single missing teeth in a Turkish subpopulation: an implant, fixed partial denture, or no restoration

Zeynep Özkurt*, Ender Kazazoğlu

Department of Prosthodontics, Faculty of Dentistry, Yeditepe University, Istanbul 34728, Turkey

Received 24 August 2010; accepted 28 October 2010
Available online 16 November 2010

KEYWORDS
fixed partial denture;
implant;
single-tooth replacement

Abstract *Background/purpose:* The aim of this study was to compare the frequency of 3 treatment alternatives in a Turkish subpopulation with a single missing tooth: implant retained crowns (IRCs), fixed partial dentures (FPDs), and no replacement.
Materials and methods: A study comparing 3 different treatment alternatives for a single missing tooth was conducted. Data were collected by panoramic radiographic examination. Age, gender, and treatment method for a single missing tooth were recorded. Differences between the groups were examined using one-way ANOVA, and multiple comparisons were evaluated by using Tukey's HSD test. A Chi-squared test was used to compare qualitative data. The significance level was set to 5%.
Results: Of 1953 examined radiographs, 218 (11.16%) patients were found to have a single missing tooth. Of these 218 patients, 101 (46.3%) had FPD restorations, and 23 (10.6%) had IRCs. Ninety-four (43.1%) patients had no restorations. The mean age of patients with FPDs was significantly higher than that of patients with no restorations ($P < 0.01$). There were no significant differences between treatment modality or gender ($P > 0.05$). FPDs and IRCs in the anterior region were significantly more prevalent compared to the posterior region ($P < 0.01$).
Conclusions: The great majority of patients with a single missing tooth had a higher interest in FPDs than IRCs. Patients with no replacement were also prevalent.

* Corresponding author. Department of Prosthodontics, Faculty of Dentistry, Yeditepe University, Bağdat cad. No: 238, Goztepe, Istanbul 34728, Turkey.
E-mail address: zeynepozkurt@hotmail.com (Z. Özkurt).

doi:10.1016/j.jds.2010.11.002

Introduction

Tooth loss caused by recurrent caries, traumatic incidents, endodontic complications, or periodontal diseases is an important event that may lead to functional disability of the masticatory system.[1,2] In addition to those factors, congenital failures, dental experience, therapeutic skill, and treatment planning may also determine the survival rate and cause loss of teeth.[3] The prosthetic replacement of missing teeth is an important element of dental care. Patients with a single missing tooth can be treated with removable partial dentures, resin-bonded fixed partial dentures (RBFPDs), tooth-supported fixed partial dentures (FPDs), and implant-retained crowns (IRCs). A single tooth extraction with no tooth replacement is also an alternative treatment modality.[4]

Although it is possible to replace a single tooth with removable prostheses or RBFPDs, they should be considered provisional instead of definitive restorations. RBFPDs were introduced as an alternative to FPDs after Rochette used this restoration as a periodontal splint.[5] This method is more conservative because tooth preparations are limited to the lingual surfaces of abutting teeth. However, preparations are more technically sensitive. They must remain in the enamel, and adequate interocclusal space for the restorations should be provided. Major disadvantages of RBFPDs are fracture and debonding which were reported to occur in 25—36% of cases.[6,7]

FPDs and IRCs are the most commonly preferred definitive treatment options for a single missing tooth.[8] For many years, FPDs were considered to be the best treatment choice for replacing a single missing tooth. Survival rates of these FPDs were 77.8—89.2% after 10 years.[9,10] The primary reasons for suggesting FPDs are its clinical ease and reduced treatment time and costs.[11] Nowadays, IRCs have become the most common treatment of choice in many clinical cases with a single missing tooth. Replacement of a single tooth using an osseointegrated implant is an accepted and satisfactory treatment. IRCs have definite advantages including esthetics and function with long-term predictability. They are an ideal treatment for replacing a single tooth in many situations.[12] Survival rates of IRCs were 94.5% after 5 years[13] and 89.4% after 10 years[10] in 2 systematic reviews. Misch reviewed the success of treatment options of a single missing tooth and stated that IRCs exhibited the highest survival rates among treatment modalities. In addition, the adjacent teeth have the highest survival rate and the lowest complication rate, which is a considerable advantage.[11] Although there are many advantages of implants, time-consuming protocols and economic aspects may affect the decision to replace a single tooth with an IRC.[14]

Knowledge of the various treatment options and prevalence data in a clinical situation is important for public health planners, in order to estimate costs of health insurance. To our knowledge, there are no data available on the epidemiologic evaluation of treatment modalities of a single missing tooth in a Turkish population in Istanbul. Therefore, the aim of the present study was to assess the prevalence of 3 different treatment alternatives in dental patients with a single missing tooth in a Turkish population, and evaluate whether FPDs or IRCs were used. The working hypothesis was that the prevalence of FPDs would be higher than other treatment alternatives.

Figure 1 An example of examined panoramic radiographs with a 3-unit fixed partial denture.

Materials and methods

This study evaluated dental patients in a Turkish subpopulation, consisting of a patient group attending the Faculty of Dentistry, Yeditepe University, Istanbul, Turkey from December 2007 to November 2008. The retrospective evaluation was conducted by examining panoramic radiographs on a digital record system of the faculty, which involved all patient files from undergraduate, postgraduate, and assistant professor clinics. The panoramic radiographs were taken from all patients who were given a general dental examination before any treatment, which is a routine procedure. All radiographs were selected and evaluated by a prosthodontist. The inclusion criteria were: 1) patients were older than 18 years, 2) patients had only 1 missing tooth, and 3) the missing tooth had 3 feasible FPDs (adjacent teeth were present and missing spaces were bordered by 1 or more natural teeth on both sides). Data were analyzed based on age, gender distribution, missing tooth location, and treatment modality. Three treatment modalities for a single missing tooth (FPD, IRC, and no replacement) were compared (Figs. 1 and 2).

Statistical analyses

NCSS 2007 & PASS 2008 Statistical Software (Kaysville, UT, USA) was used for the statistical analysis. Differences between groups were examined using one-way analysis of variance (ANOVA), and multiple comparisons were made using Tukey's honest significant difference (HSD) test. A

Figure 2 An example of examined panoramic radiographs with an implant restoration.

Table 1 Comparison of restorations of a single missing tooth.

Treatment modality	*n*	%	P
Fixed partial denture	101	46.33	0.001*
Implant	23	10.55	
With no restoration	94	43.11	
Total	218	100	

*Chi-squared test, $P < 0.01$.

Chi-squared test was used to compare qualitative data. The significance level was set to 5%.

Results

In total, 218 radiographs from 1953 patients met the inclusion criteria. A single missing tooth was seen in 218 (141 females and 77 males) among 1953 examined radiographs. Thus, the prevalence rate of a single missing tooth was 11.16%. The frequencies of treatment alternatives are shown in Table 1. In 218 patients, 101 patients had FPDs (46.3%), 23 patients had IRCs (10.6%), and 94 patients had no restorations (43.1%). IRCs were seen less frequently than the other treatment alternatives ($P = 0.001$).

Age factor

Patients ranged in age from 18 to 74 years, with mean age of 41.67 ± 12.57 years. The mean ages were 45 years for FPDs, 42.43 years for implants, and 37.87 years for no restoration. There was a statistically significant difference between the age and treatment modality ($P = 0.001$), and the results are shown in Table 2. According to the multiple-comparison test (Tukey's HSD test), the mean age of patients with FPDs was significantly higher than that of patients with no restorations ($P = 0.001$). There was no significant difference between the mean ages of patients with IRCs and FPDs ($P = 0.633$). Similarly, there was no significant difference between mean ages of patients with IRCs and those with no restorations ($P = 0.243$) (Table 3).

Gender factor

The frequencies of treatment modalities by gender are shown in Table 4. Of the 218 patients, 77 (35.3%) were males and 141 (64.7%) were females. There was no statistically significant difference between treatment modalities and gender ($P = 0.222$).

Mouth region

There was no statistically significant difference between treatment modalities in the mandible and maxilla ($P = 0.331$). However, there was a statistically significant difference between treatment modalities in the anterior and posterior region ($P = 0.001$). FPDs and IRCs in the anterior region were significantly more prevalent compared to the posterior region ($P = 0.001$). On the other hand, patients with no restorations in the posterior region were significantly more prevalent compared to the anterior region ($P = 0.001$) (Table 5).

Table 3 Tukey's HSD test among treatment modalities according to age.

Treatment modality	Mean difference	P
Fixed partial denture versus implant	2.57	0.633
Fixed partial denture versus no restoration	7.13	0.001*
Implant versus no restoration	4.56	0.243

*$P < 0.01$.

Distribution of the missing teeth

The distribution of missing teeth is shown in Table 6. Fifty-three (24.3%) patients had a missing lower left first molar, which accounted for the highest percentage, and there was 1 (0.5%) patient whose upper right second molar teeth and 1 (0.5%) patient whose lower right second molar teeth were missing with the lowest percentage. One hundred twenty-two patients (56%) had a missing tooth in the mandible, and 96 patients (44%) had a missing tooth in the maxilla (Table 7). Seventeen patients (7.8%) had a missing tooth in the anterior region, and 201 patients (92.2%) had a missing tooth in the posterior region (Table 8).

Discussion

This is the first study of the prevalence of different treatment alternatives for a single missing tooth in a Turkish sample. Based on the results obtained, the proposed hypothesis was supported. The great majority of patients with single missing teeth showed a very high interest in treatment with FPDs (46.3%), but some of the patients received implant treatment (10.6%).

Many factors may explain these results. First of all, implant services involve higher fees than traditional services such as FPDs, and dental insurance does not financially support implant therapy in Turkey. The average income in Turkey was US$10,000 in 2009,[15] and only the costs of FPDs without laboratory expenses are met by the national insurance system. Insured patients have to pay almost 4-times higher fees for an IRC compared to the laboratory costs of a 3-unit FPD, if the adjacent teeth in the region of the missing tooth do not require additional

Table 2 Evaluation of age according to treatment modality.

	Fixed partial denture mean (SD)	Implant mean (SD)	No restoration mean (SD)	P
Age (yrs)	45.00 (11.60)	42.43 (14.65)	37.87 (12.09)	0.001*

*One-way ANOVA, $P < 0.01$.

Table 4 Evaluation of gender according to treatment alternatives.

	Fixed partial denture *n* (%)	Implant *n* (%)	No restoration *n* (%)	P
Male	32 (31.7%)	6 (26.1%)	39 (41.5%)	0.222*
Female	69 (68.3%)	17 (73.9%)	55 (58.5%)	
Total	101 (100%)	23 (100%)	94 (100%)	

*Chi-squared test, $P > 0.05$.

restorations such as crowns. The costs may increase, as even additional surgical procedures such as lifting and grafting are required when bone and soft tissues are inadequate. Therefore, the higher cost of implant therapy may cause patients to choose FPDs.

On the other hand, an FPD is usually completed in a short time. The treatment time for a 3-unit FPD is only 2 weeks.[16] An implant-retained crown takes longer to complete because of the waiting period for osseointegration, which is about 4–6 months. If this period were extended without a temporary restoration, this would have negative effects on both esthetics and function, especially with a 2-stage implant protocol. Many patients do not want to wait such a long time. Additional surgical procedures would extend this period.[17] Early and immediate loading of the implant is an alternative to conventional loading, and decreases the treatment time.

Implants require clinical training which is insufficiently addressed in undergraduate dental education programs of dentistry facilities. Implant treatments are not within the ability of all restorative dentists.[12] Postgraduate education or implant courses should be taken to learn proper implant therapy. However, an FPD is within the ability of most restorative dentists. Therefore, dentists who treat patients with FPDs may have hesitated to offer implant therapy to patients of this study, because of their inexperience. Although FPDs may be applied to all patients, implant therapy requires surgical procedures, and it may be contraindicated for patients who have severe systematic disorders such as uncontrolled diabetes mellitus or a smoking habit.[17] Patients may also be afraid to undergo a surgical intervention, because they usually think that such a procedure is painful.

When the distribution of treatment alternatives between both sexes was evaluated, it was seen that there was no difference between males and females. However, a single tooth extraction with no tooth replacement was more common than FPDs among younger Turkish people. The possible reason for this difference may be an increase in necessity or demand to have a functional prosthetic restoration as one gets older. Younger patients whose teeth were newly extracted might not yet have decided to get a restoration for a single missing tooth. On the other hand, there was no statistically significant difference between the ages of patients who had an FPD and IRC or who had an IRC and no restoration.

Although there was no statistically significant difference between treatment modalities in the mandible and maxilla, the distribution of treatment modalities between the anterior and posterior regions varied. There were more FPDs (70.6%) and IRCs (29.4%) in the anterior region than in the posterior region, at 44.4% and 9.0%, respectively. On the other hand, there were significantly more patients with no restorations in the posterior region (46.8%) compared to the anterior region (0%). Actually, no patient had a single missing tooth without a tooth replacement in the anterior. This difference was particularly associated with esthetic requirements which are of paramount importance to most patients.

There were 94 (43.1%) patients with a single missing tooth with no replacement. This rate is quite high because a single missing tooth especially in the posterior region might not adversely affect either esthetics or function. From a patient's perspective, replacing a missing posterior tooth might seem less important.[18] However, rotating, tilting, and shifting of the adjacent teeth or overeruption of the antagonist teeth into the empty space is possible, and this can complicate subsequent construction of a prosthetic restoration or compromise function and esthetics.[19]

When the distribution of regions with missing teeth was evaluated, it was found that loss of a single tooth was more frequent among posterior teeth (92.2%) compared to anterior teeth (7.8%). This result was supported by Mack et al.[3] The first molar was the most frequent tooth missing among all patients; 53 (24.3%) patients had lost their lower left first molar and 47 (21.6%) patients had lost their lower right first molar. This result was also supported by Mack et al.[3,20] and is attributed to fact that first molar teeth are the first permanent teeth to erupt, and they might be more susceptible to caries, endodontic treatment, and extraction.[21]

Treatment decisions for a single missing tooth must be based on a scientific study of clinical outcomes including

Table 5 Evaluation of treatment alternatives according to the region of the missing tooth.

	Fixed partial denture Mean (%)	Implant Mean (%)	No restoration Mean (%)	P
Mandible	52 (42.6%)	12 (9.8%)	58 (%47.5)	0.331
Maxilla	49 (51.0%)	11 (11.5%)	36 (%37.5)	
Anterior	12 (70.6%)	5 (29.4%)	0 (%0)	0.001*
Posterior	89 (44.4%)	9 (9.0%)	46 (%46.8)	

*Chi-squared test, $P < 0.01$.

Table 6 Distribution of the missing single teeth.

Region	Missing tooth	*n*	%
Upper right	Central incisor	3	1.4
	Lateral incisor	2	0.9
	Canine	5	2.3
	1st premolar	7	3.2
	2nd premolar	12	5.5
	1st molar	14	6.4
	2nd molar	1	0.5
Upper left	Central incisor	2	0.9
	Canine	3	1.4
	1st premolar	6	2.8
	2nd premolar	15	6.9
	1st molar	23	10.6
	2nd molar	3	1.4
Lower left	Lateral incisor	2	0.9
	2nd premolar	7	3.2
	1st molar	53	24.3
	2nd molar	4	1.8
Lower right	2nd premolar	8	3.7
	1st molar	47	21.6
	2nd molar	1	0.5

clinical, psychosocial, and economical measures.[4] Many factors should be considered when choosing an FPD or IRC for prosthetic reconstruction of a single missing tooth.[1,12] When considering either of these treatment alternatives, the clinician must take into account the risks and benefits of each approach.[5] Systematic reviews of implant-retained single crowns show that failure of osseointegrated implants usually occur in earlier stages of the follow-up period.[22,23] Esthetic failures in implant dentistry are more common than mechanical failures, especially in the anterior region.[24] Clinicians should take into consideration esthetic risk factors such as high patient expectations, a high smile line, poor gingival quality, poor papillary morphology, and low bone height. These factors often lead to patient dissatisfaction with implant dentistry, and should be properly managed.[25]

There are advantages and disadvantages of both treatment procedures. An FPD requires reducing the abutting teeth which can result in several biological and technical risks such as endodontic/periodontal complications, secondary caries, and loss of retention or tooth fracture.[1,26] If the abutting teeth have large restorations, they would benefit from abutment preparation. However, if they are untouched teeth, they would be damaged by such preparations. Based on clinical experience, if 1 part of a bridge fails, the entire restoration fails, often with the loss of an abutting tooth.[12] The main advantage of the IRC is that the adjacent teeth do not need to be prepared. These teeth are left in their current state and are not connected as a part of a larger restoration. The adjacent teeth have a better prognosis, as they are not subjected to a higher incidence of endodontic therapy and decay as a result of tooth preparation.[11,27] Economic parameters are also decisive factors in the preference of a particular type of treatment.[26] It is very important to emphasize to patients that the quality of life far outweighs the differential in fees. Patients should be properly advised of the advantages and disadvantages of both types of treatment modalities, so they can make an informed decision.

Table 7 Evaluation of the region with single missing teeth.

Region with missing teeth	*n*	%
Mandible	122	56.0
Maxilla	96	44.0
Total	218	100

Table 8 Evaluation of the region with single missing teeth.

Region with missing teeth	*n*	%
Anterior	17	7.8
Posterior	201	92.2
Total	218	100

In conclusion, it was found in the present study that a subpopulation in Istanbul, Turkey was more likely to have a fixed partial denture instead of an implant-retained crown when one of their teeth was lost. Many patients might not have the education or background to make an informed decision between an implant and a fixed partial denture. In our opinion, all patients with a missing tooth should be provided with adequate information to make a judgment about these 2 common treatment alternatives as well as possible adverse effects of leaving the missing tooth without a replacement.

References

1. Salinas TJ, Block MS, Sadan A. Fixed partial denture or single-tooth implant restoration. Statistical considerations for sequencing and treatment. *J Oral Maxillofac Surg* 2004;62:2—16.
2. Hessari H, Vehkalahti MM, Eghbal MJ, Murtomaa H. Tooth loss and prosthodontic rehabilitation among 35- to 44-year-old Iranians. *J Oral Rehabil* 2008;35:245—51.
3. Mack F, Samietz SA, Mundt T, et al. Prevalence of single-tooth gaps in a population-based study and the potential for dental implants-data from the Study of Health in Pomerania (SHIP-0). *J Craniomaxillofac Surg* 2006;34:82—5.
4. Torabinejad M, Anderson P, Bader J, et al. Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: a systematic review. *J Prosthet Dent* 2007;98:285—311.
5. Rochette AL. Attachment of a splint to enamel of lower anterior teeth. *J Prosthet Dent* 1973;30:418—23.
6. Vallittu PK. Survival rates of resin-bonded, glass fiber-reinforced composite fixed partial dentures with a mean follow-up of 42 months: a pilot study. *J Prosthet Dent* 2004;91:241—6.
7. van Heumen CC, van Dijken JW, Tanner J, et al. Five-year survival of 3-unit fiber-reinforced composite fixed partial dentures in the anterior area. *Dent Mater* 2009;25:820—7.
8. Salinas TJ, Eckert SE. In patients requiring single-tooth replacement, what are the outcomes of implant- as compared to tooth-supported restorations. *Int J Oral Maxillofac Implants* 2007;22:71—95.

9. Lang NP, Pjetursson BE, Tan K, Brägger U, Egger M, Zwahlen M. A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years. II. Combined tooth—implant-supported FPDs. *Clin Oral Implants Res* 2004;15:643—53.
10. Pjetursson BE, Brägger U, Lang NP, Zwahlen M. Comparison of survival and complication rates of tooth-supported fixed dental prostheses (FDPs) and implant-supported FDPs and single crowns (SCs). *Clin Oral Implants Res* 2007;18:97—113.
11. Misch CE. Maxillary anterior single-tooth replacement. In: *Dental implant prosthetics*. St. Louis: Mosby, 2005:368—413.
12. Hebel K, Gajjar R, Hofstede T. Single-tooth replacement: bridge versus implant-supported restoration. *J Can Dent Assoc* 2000;66:435—8.
13. Jung RE, Pjetursson BE, Glauser R, Zembic A, Zwahlen M, Lang NP. A systematic review of the 5-year survival and complication rates of implant-supported single crowns. *Clin Oral Implants Res* 2008;19:119—30.
14. De Rouck T, Collys K, Cosyn J. Single-tooth replacement in the anterior maxilla by means of immediate implantation and provisionalization: a review. *Int J Oral Maxillofac Implants* 2008;23:897—904.
15. United Nations Statistics Division. Department of Economic and Social Affairs (updated in December 2009).
16. Christensen GJ. Three-unit fixed prostheses versus implant-supported single crowns. *J Am Dent Assoc* 2008;139:191—4.
17. Sclar AG. Strategies for management of single-tooth extraction sites in aesthetic implant therapy. *J Oral Maxillofac Surg* 2004; 62:90—105.
18. Tervonen T. Condition of prosthetic constructions and subjective needs for replacing missing teeth in a Finnish adult population. *J Oral Rehabil* 1988;15:505—13.
19. Sadan A, Blatz MB, Salinas TJ, Block MS. Single-implant restorations: a contemporary approach for achieving a predictable outcome. *J Oral Maxillofac Surg* 2004;62:73—81.
20. Mack F, Mundt T, Mojon P, et al. Study of Health in Pomerania (SHIP): relationship among socioeconomic and general health factors and dental status among elderly adults in Pomerania. *Quintessence Int* 2003;34:772—8.
21. King NM, Shaw L, Murray JJ. Caries susceptibility of permanent first and second molars in children aged 5—15 years. *Community Dent Oral Epidemiol* 1980;8:151—8.
22. Lindh T, Gunne J, Tillberg A, Molin M. A meta-analysis of implants in partial edentulism. *Clin Oral Implants Res* 1998;9:80—90.
23. Creugers NH, Kreulen CM, Snoek PA, de Kanter RJ. A systematic review of single-tooth restorations supported by implants. *J Dent* 2000;28:209—17.
24. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications with implants and implant prostheses. *J Prosthet Dent* 2003;90:121—32.
25. Tang CS, Naylor AE. Single-unit implants versus conventional treatments for compromised teeth: a brief review of the evidence. *J Dent Educ* 2005;69:414—8.
26. Brägger U, Krenander P, Lang NP. Economic aspects of single-tooth replacement. *Clin Oral Implants Res* 2005;16:335—41.
27. Newman MG, Takei HH, Carranza FA. Clinical aspects of dental implants. In: *Carranza's Clinical Periodontology*, 9th ed. Philadelphia: WB Saunders, 2002:889—96.